A Systematic Approach To Abnormal Chest Images: Radiographs And Computed Tomograms

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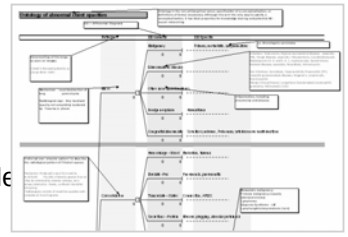
Overview

- Definitions
- Patterns
- DDG
- DDS
- Cases, example
- Review



DEFINITIONS

- Pattern - seen on images
  - 5 major categories
- Disease - seen on specimens
- DDG: Differential Diagnosis, General
- DDS: Differential Diagnosis, Specific

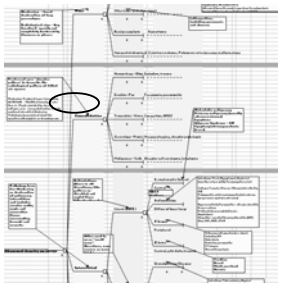
Radiology Interpretive Steps: A Review: ID CD

Important to do in order, don't jump to dx
helps think through the process, arrive at dx

- Identify the abnormality
- Define the appearance (be definitive)
- Categorize (when able), i.e. patterns, grades
- Differential Diagnosis
  - General
  - Specific

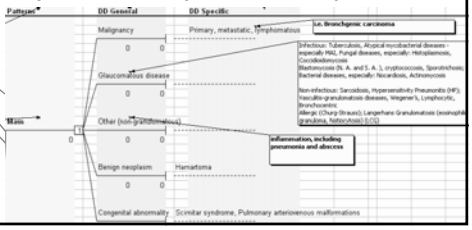
Major Pattern Categories

- **Mass**
- **Consolidative**
- **Interstitial**
  - **Linear**
  - **Nodular**
- **Vascular**
- **Airway**
  - **Obstructive**
  - **Wall thickened**



Mass

- **Mechanism** - Local destruction of lung parenchyma
- **Radiological sign** - Any localized opacity not completely bordered by fissures or pleura



Mass Differential Diagnosis

- Malignancy - Primary or secondary
- Granulomatous disease - Infectious or noninfectious, active or inactive
- Other inflammation, including pneumonia and abscess
- Benign neoplasm
- Congenital abnormality

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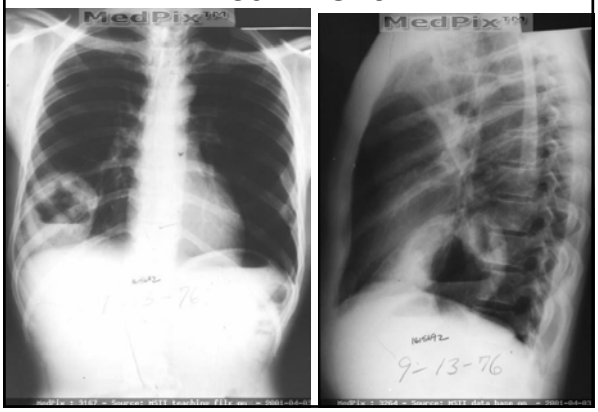

Bronchgenic carcinoma

- **ACR Codes: 63.3224**
  FINDINGS:
  A cavitated round opacity is present at the right lung base. It overlies the back of the heart shadow on the lateral view.
  There are nodular opacities inside the cavity and an air-fluid level is also visible. The location is thus right lower lobe, with possible involvement of the posterior portion of the middle lobe.

  PATTERN:
  The definition of a mass is satisfied.

  DIFFERENTIAL DIAGNOSIS:
  Malignancy is favored over inflammation because of the irregularity of the inner wall of the cavity. The air-fluid level is not useful in differential diagnosis; it indicates only that the bronchus connected to the mass is either partially or intermittently obstructed.

  DIAGNOSIS:
  Bronchogenic carcinoma, adenomatous

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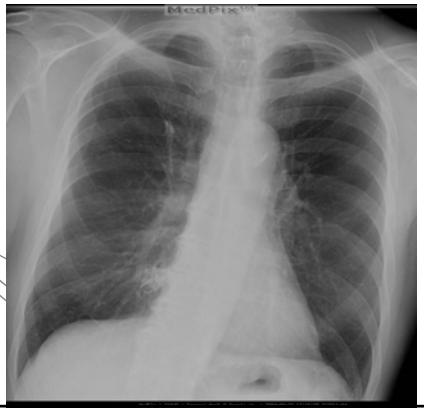

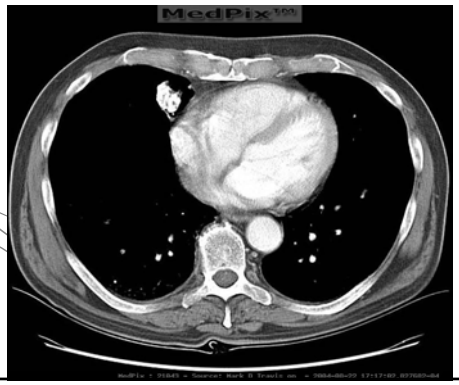

Pulmonary Hamartoma

- **Hamartomas are benign neoplasms with 90% being found in lung. They are approximately 5% of all solitary lung nodules. Plain radiographs demonstrate well-circumscribed peripheral rounded or lobulated tumor. They frequently contain cartilage with fibrous connective tissue and various amounts of fat, smooth muscle, and seromucous glands. Approximately 30% contain calcium usually of the "popcorn" variety. They are seen most commonly in 4th and 5th decades of life. They are rare in children.**

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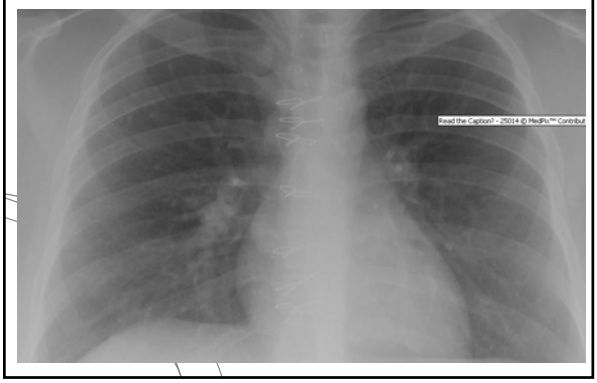
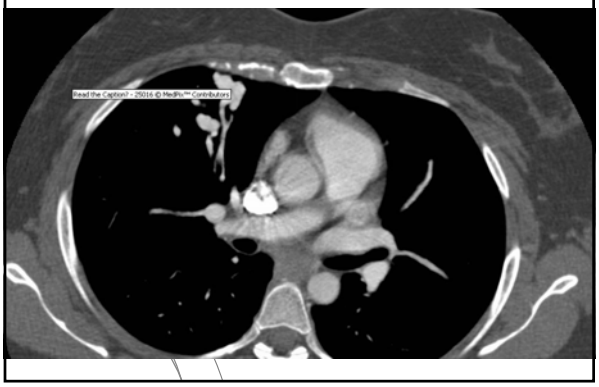




Pulmonary Arteriovenous Malformation

- **Pulmonary AVM's are abnormal connections between the pulmonary arteries and veins.**
- **They are single in 65%, multiple in 35%. Twice as common in women than men, the majority are congenital and are found in the lower lobes.**
- **Significantly, nearly 70% are associated with Hereditary Hemorrhagic Telangiectasia (Rendu-Osler-Weber disease), an autosomal dominant condition involving multiple AVM's in the brain, lung, skin, and liver.**

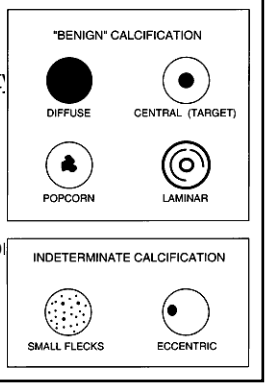
Mass Considerations

- Clinical variables
  -Age
  -Symptoms and signs
- Risk factors
  -Smoking
  -Occupation, exposure
  -Previous carcinoma
  -Concurrent disease
- Note:
  - Mass DD included in some vascular and nodular patterns
    - And the other way around: shades of grey

Mass Considerations

- Crucial appearance characteristics for inactivity

  -**Calcification**
  - Central, lamellar
- **Evolution**
  - 2 year stability or regressio



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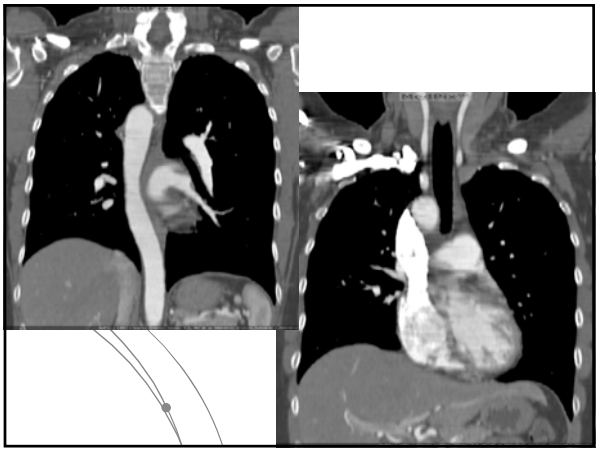

- **Chest plain film: Right sided aortic arch, the lateral view shows an opacity located posterior to the esophagus ans anterior displacement of the trachea.**

  Barium swallow: Extrinsic compression on the posterior wall of the esophagus.

  Chest CT: Right sided arch and an aberrant left subclavian artery arising from a large aortic diverticulum and traveling posterior to the esophagus causing compression on the posterior esophageal wall.

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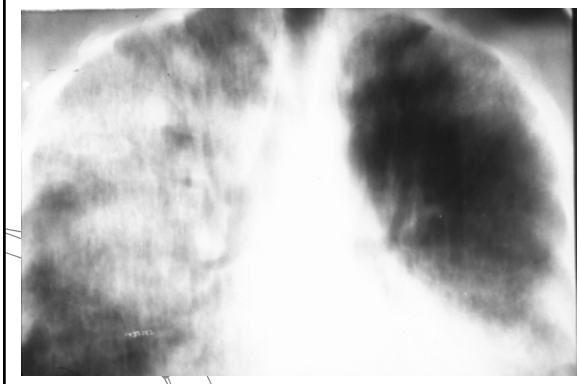
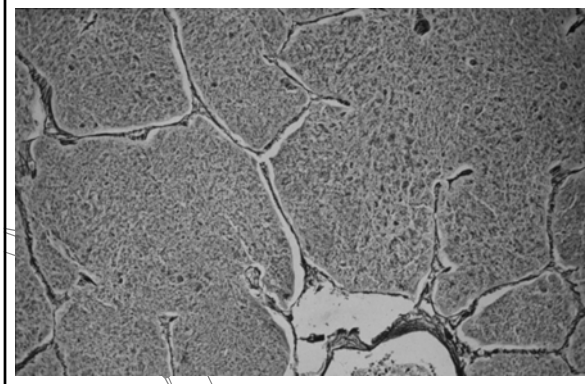
Consolidative (Alveolar) Pattern

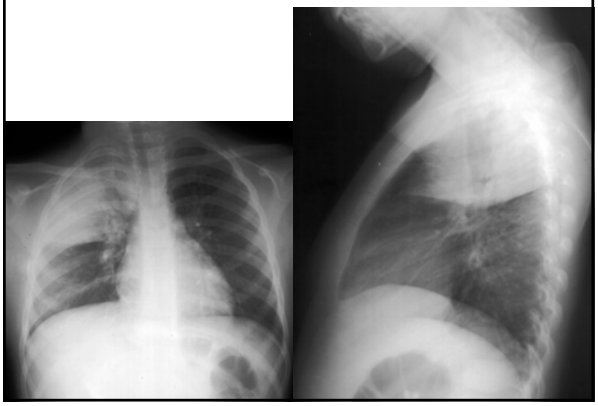
- Mechanism
  -Produced in pure form and by **ALVEOLAR FILLING of density greater than air**
  -May be mimicked by alveolar collapse, as in airway obstruction
  -Rarely, confluent interstitial thickening
- Radiologicaly consists of cloud-like opacities with complete air-bronchograms

Consolidative (alveolar) Pattern Cont.

- Radiological signs
  -Fluffy, cloud-like, coalescent opacities
  -Sharp edges when limited by fissures or pleura
  -Complete air bronchograms







RUL Pneumonia

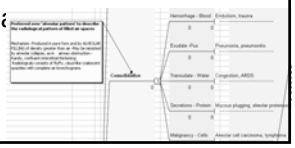
- Large area of opacification on the frontal view has both major and minor fissures as its inferior border.
- The lateral view demonstrates nicely the fissures of the right lung. Both RML and RLL remain well areated.
- MSU Top 10 CXR dx
  - www.rad.msu.edu/.../im_tutor/images/

Bacterial pneumonia

- **Streptococcus pneumoniae is the most common cause of bacterial pneumonia**
- **May present with mild to severe symptoms, including shaking chills, chattering teeth, severe chest pain, and a cough productive of rust-colored or greenish sputum**
- **May be febrile, diaphoretic, tachypneic, dyspneic, and/or cyanotic.**

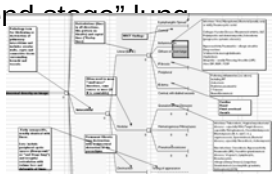
Consolidative (alveolar) Pattern: Differential Diagnosis

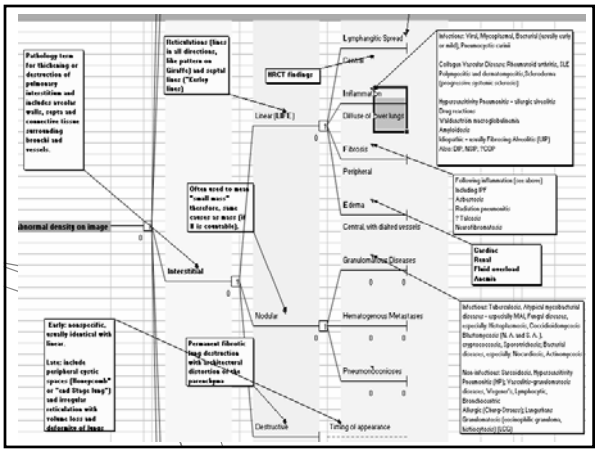
- Hemorrhage - **BLOOD** - embolism, trauma
- Exudate - **PUS** - pneumonia, pneumonitis
- Transudate - **WATER** - congestion, ARDS
- Secretions - **PROTEIN** - Mucous plugging, Alveolar proteinosis
- Malignancy - **CELLS** - Alveolar cell carcinoma, Lymphoma



INTERSTITIAL PATTERN

- Mechanism
  -thickening of lung interstices
  -architectural destruction of interstitium
  - honeycomb or “end-stage” lung



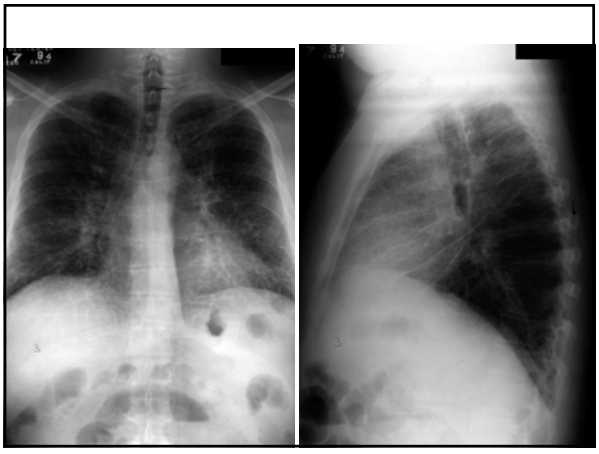


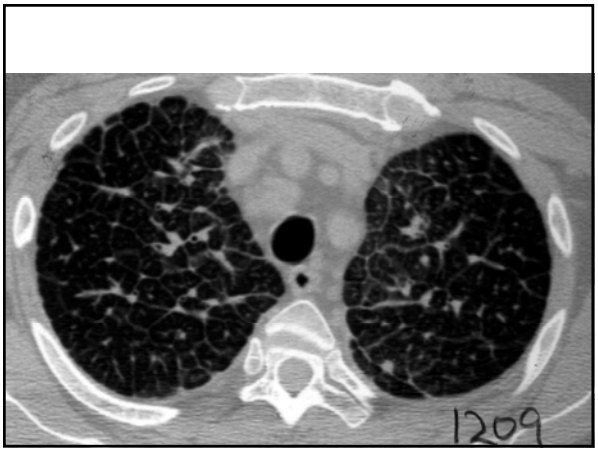
Interstitial Pattern, Radiological signs

Linear form - reticulations (lines in all directions), septal lines (Kerley lines)

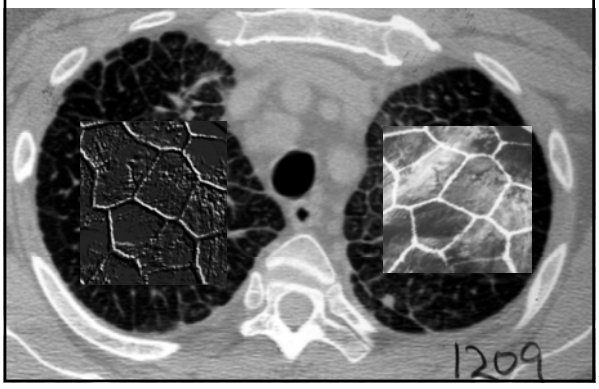
Nodular form - small, sharp, numerous, evenly distributed, uniform (especially uniform in shape) nodules

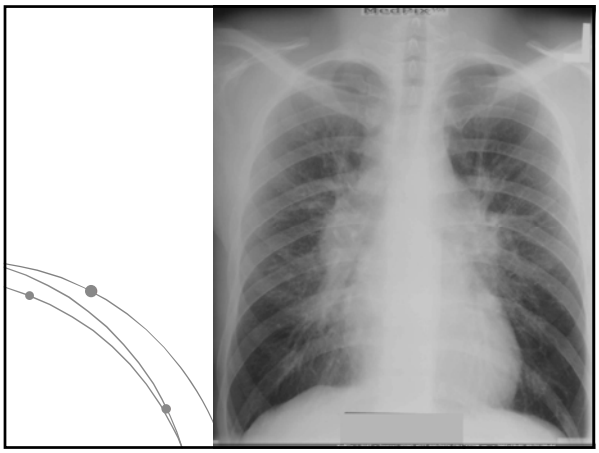
Destructive form - peripheral, irregular cyst formation





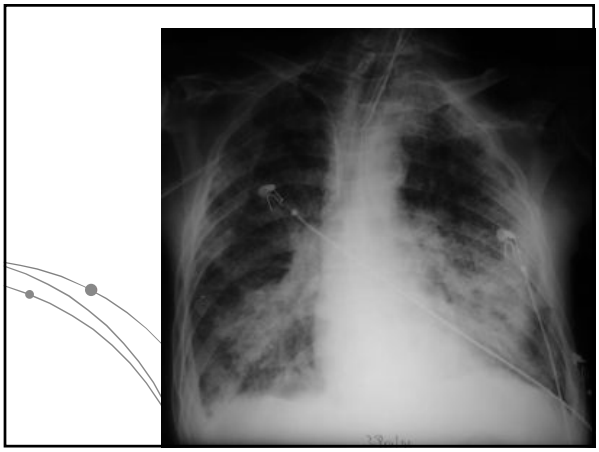
Lymphangitic Spread

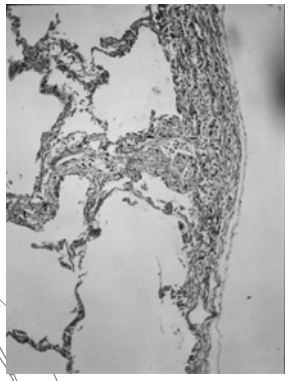


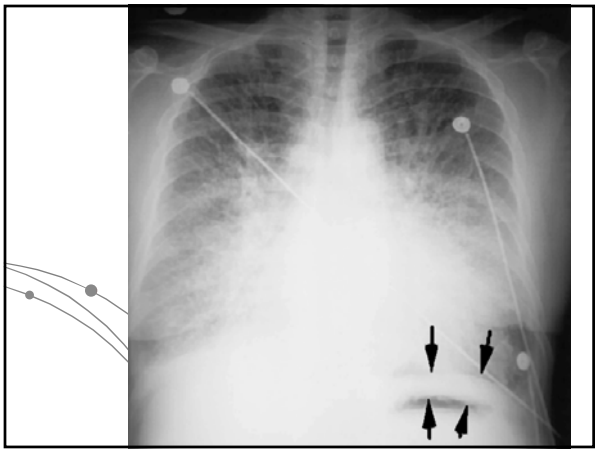


Sarcoid

- **A** granulomatous disease of unclear etiology, most commonly recognized by its thoracic manifestations of interstitial lung disease and hilar and mediastinal adenopathy.
- A multisystem disease, with histologic evidence of **sarcoid** involvement of the liver and spleen seen in 50-80% of all surgical specimens, although most cases do not result in organ dysfunction.







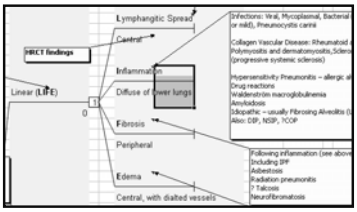
Congestive Heart Failure

- www.rad.msu.edu/.../ im_tutor/images/copd_lat.png

Interstitial Pattern Cont. Differential Diagnosis

- **Linear form - LIFE lines**

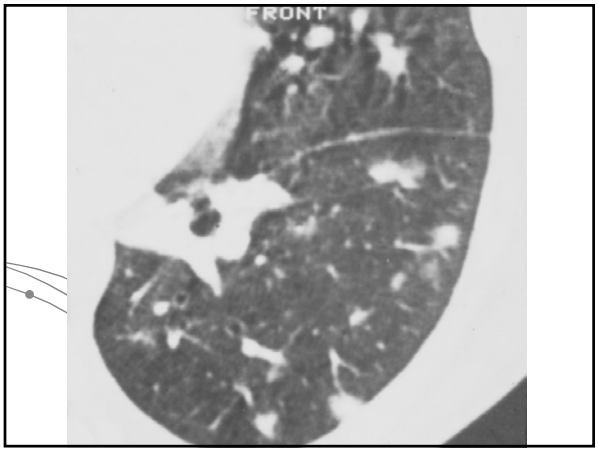
-Lymphangitic spread of malignancy
-Inflammation
-Fibrosis
-Edema



Interstitial Pattern Cont. Differential Diagnosis

- **Nodular form**

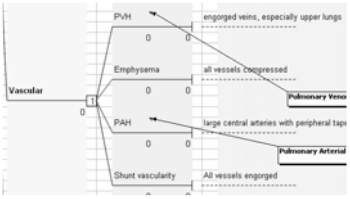
-Granulomas
-Hematogenous spread of malignancy
-Pneumonoconiosis



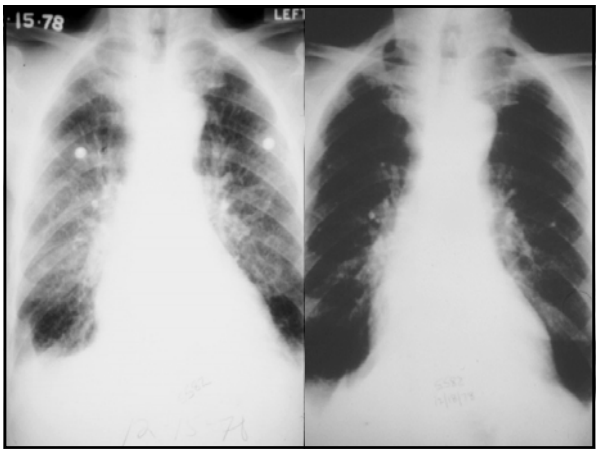
VASCULAR PATTERN

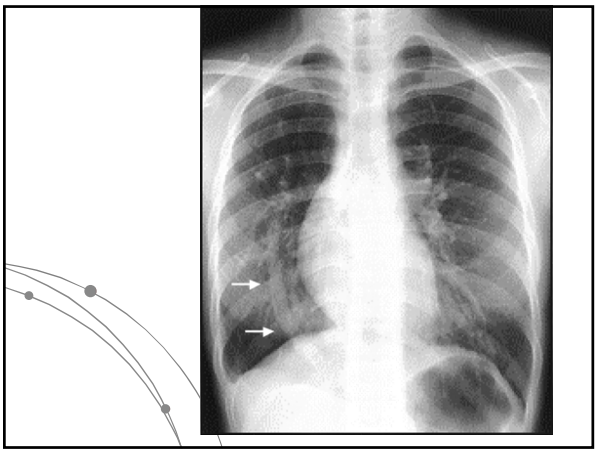
- **Mechanism** - increased or decreased perfusion altering diameter of pulmonary vessels

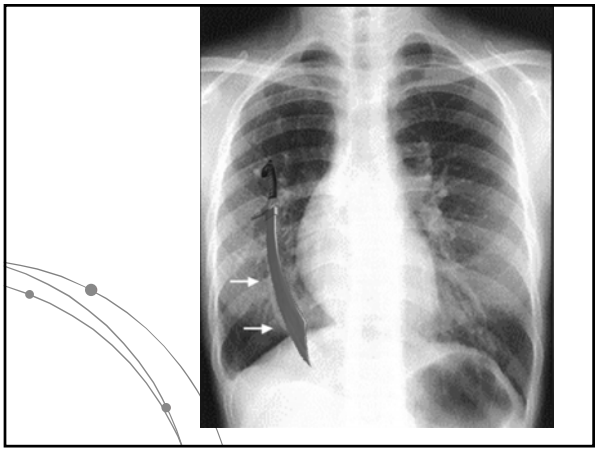
Radiological signs - changes in diameter of specific vessels



PVH







Scimitar syndrome

- A rare congenital disorder characterized by an anomalous connection of the pulmonary vein with the inferior vena cava. The anomalous vein appears as a "scimitar"-like shadow on a chest x-ray. We recently encountered Scimitar syndrome in 2 sisters and demonstrated the 3D structure of the anomalous vein by computed tomography (CT).
- http://circ.ahajournals.org/cgi/content/full/103/25/e126
  - http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=retrieve&db=pubmed&list_uids=11425786&dopt=Abstract
  - Circulation. 2001 Jun 26;103(25):E126-7.Related Articles, Links
    - **Familial scimitar syndrome: three-dimensional visualization of anomalous pulmonary vein in young sisters.**

      Ashida K, Itoh A, Naruko T, Otsuka M, Sakanoue Y, Kobayashi M, Yamashita H, Nagashima M, Shinsato T, Takanashi S, Shimizu Y, Haze K.

Vascular Pattern DDG: Examples

- Common examples
  - **Congestion** - engorged veins, especially upper lungs
  - **Emphysema** - diminished vessels
  - **Shunt vascularity** - all vessels enlarged
  - **Lymphangitic carcinoma** - irregular infiltration around vessels may resemble vessel enlargement

Vascular Pattern DDG: Examples, cont.

- **Arterial hypertension** - large central arteries with peripheral tapering
- **Thromboembolism** - locally diminished vessels with possible vessel mass centrally located
- **Bronchial circulation** - irregular vessels in unusual directions

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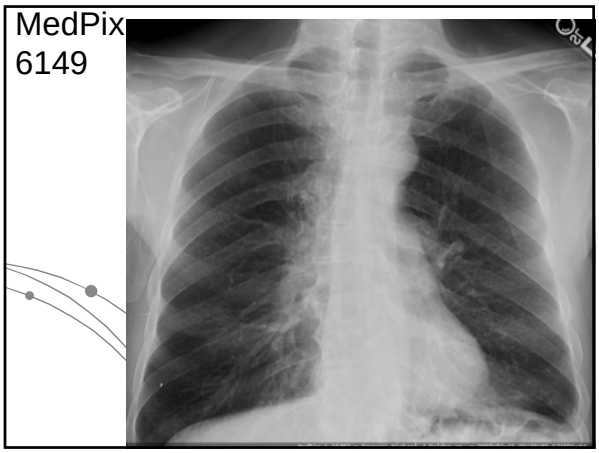
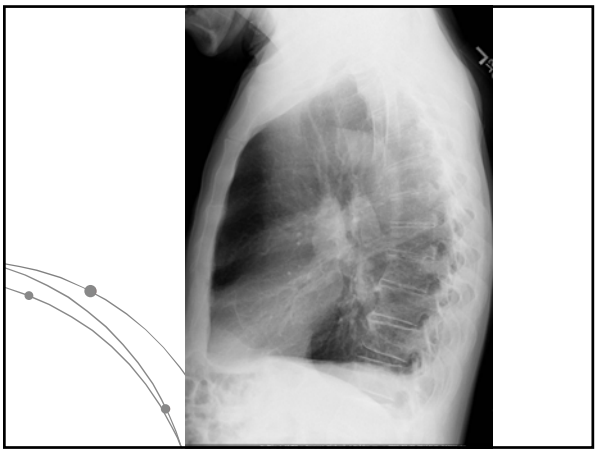
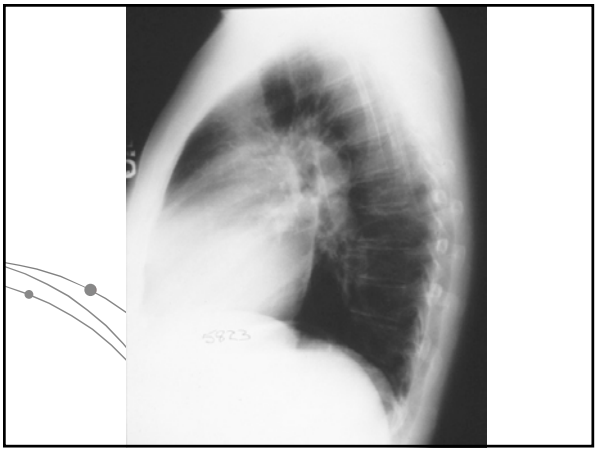
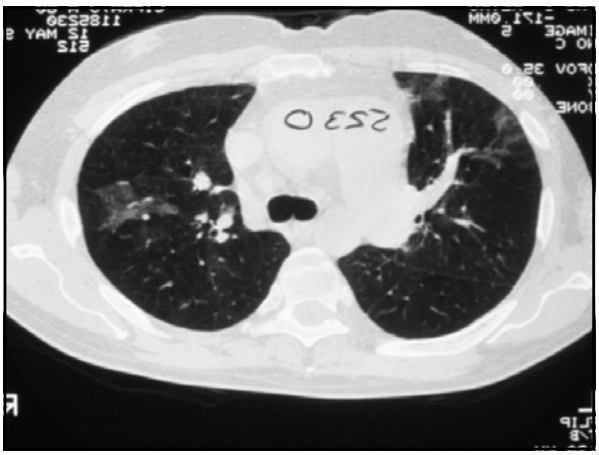
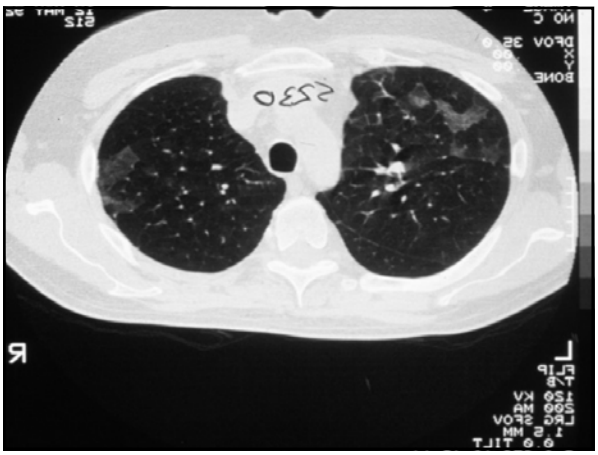










AIRWAY (BRONCHIAL) PATTERNS

- Mechanism
  - -complete or partial obstruction of airways
  - -thickening of airway walls
    - or displacement of vessels due to overaeration, COPD, etc.

Airway (bronchial) Pattern; Forms

-**Complete airway obstruction** - opacity and decreased volume

-**Partial obstruction** - lucency and increased volume

-**Wall thickening** - tram tracks, central cystic spaces or circles

Airway (bronchial) Pattern DDG

-**Opacities** - endobronchial malignancies, granulomas, inflammatory, benign or congenital masses, mucous plugs, foreign bodies

-**Lucencies** - COPD, cysts, blebs, pneumatoceles

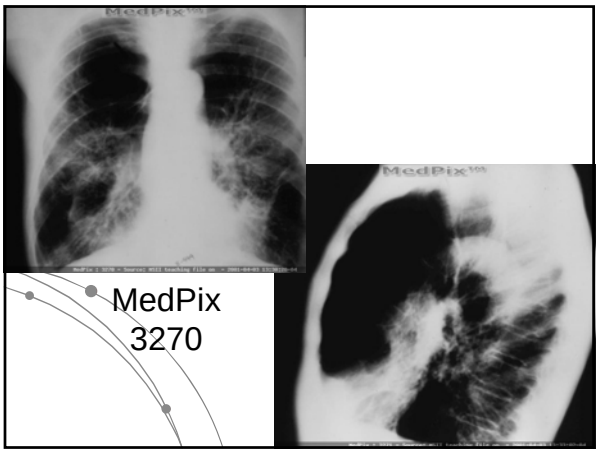
-**Thickening** - bronchiectasis, chronic bronchitis

Airway (bronchial) Patterns cont.

- Additional signs with CT
  - -Thick-walled airways, circular on end, often "signet rings"
  - -Cystic spaces centrally located
  - -Cystic spaces with very thin walls or no apparent walls
  - -Thin, stretched vessels
  - -Bronchiectasis

MedPix 9413 Cystic Fibrosis

- **The radiographic findings are largely secondary to the bronchial obstructions by the thick adherent secretions. Pulmonary hyperinflation is evidenced in this case by the narrow heart and mediastinum and the slightly depressed diaphragm. The hila are prominent and there, is lobulated contour of the right hilum consistent with the presence of adenopathy which is common in these patients. The most prominent findings in this patient are the changes related to bronchiectasis.**
- There is bronchial wall thickening seen as bronchial cuffing or "tram lines". Dilated bronchi are particularly well seen in the upper lungs where widened tubular and branching lucencies can be seen peripherally some of which containing tubular opacities representing impacted mucus.



COPD with bullous emphysema

- FINDINGS:

  The lungs are hyperinflated and the diaphragms are markedly flattened, especially on the lateral view. There are numerous lucent "holes" in the lungs and the vessels are displaced and asymmetrical.

  PATTERN:

  Air trapping is present, especially in multiple bullae with thin walls. These are the findings of bullous emphysema. Most such patients have COPD, the most common of all airway diseases.

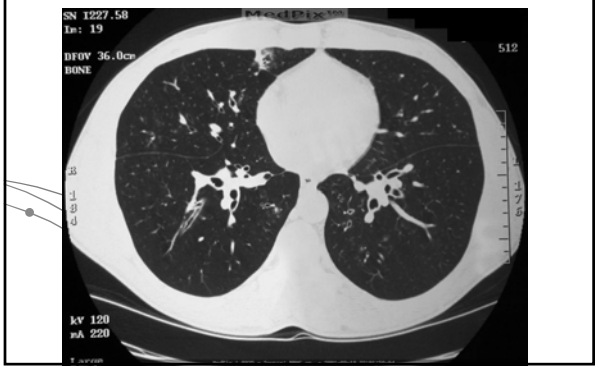
  DIFFERENTIAL DIAGNOSIS:

  A few emphysematous patients have normal airways, with abnormal elasticity of alveolar walls, such as in alpha one antitrypsin deficiency.

  DIAGNOSIS: COPD with bullous emphysema

- http://rad.usuhs.mil/medpix/medpix.html?mode=single&recnum=1696&th=-1#top

MedPix 3977



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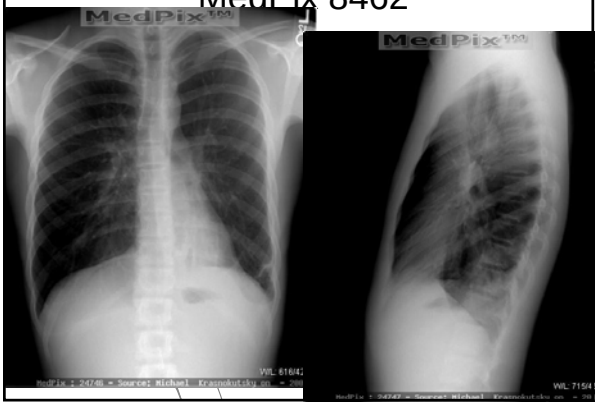
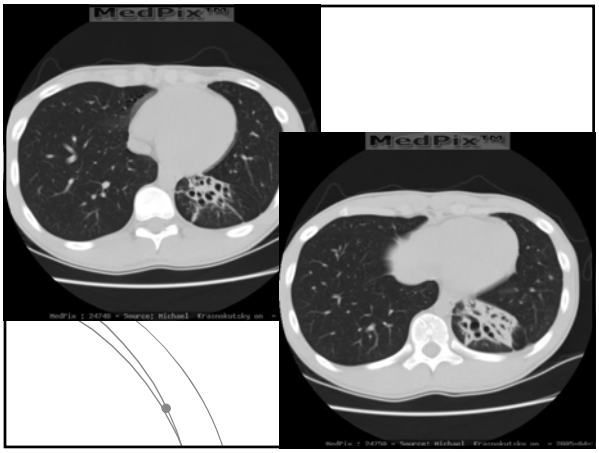




Bronchiectasis

- **Bronchiectasis is defined as irreversible local dilatation of the bronchial tree with associated bronchial wall thickening. Clinically most patients present with cough (usually chronic), recurrent infections and hemoptysis. Although not a single disease process, bronchiectasis remains a descriptive final common pathway for several distinct disease processes. Etiologies include: Post-infectious: Measles, whooping cough, TB and allergic bronchopulmonary aspergillosis)**

Small Airway Disease cont.

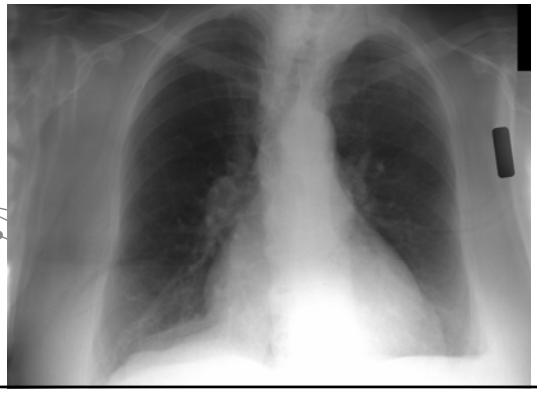
- Cases of bronchiolitis
  -Infectious - e.g., Viral, mycoplasmal
  -Allergic
  -Toxic - e.g., chlorine, phosgene
  -Idiopathic

Review: PATTERNS

- **Mass**
- **Consolidative**
- **Interstitial**
  - **Linear**
  - **Nodular**
- **Vascular**
- **Airway**
  - **Obstructive**
  - **Wall thickened**

Quiz

- What is the pattern of the following 3 images?
  1. Mass
  2. Consolidation
  3. Infiltrate
  4. Vascular
  5. Airway



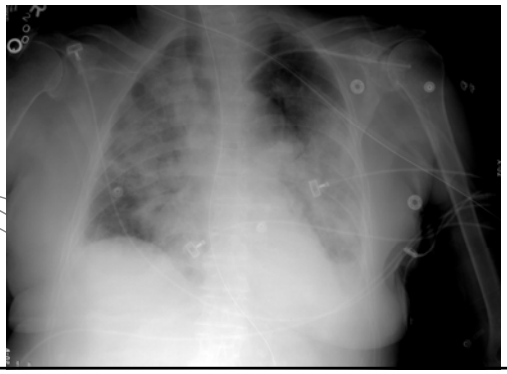
What is the pattern for those images?

1. Mass
2. Consolidation
3. Infiltrate
4. Vascular
5. Airway

What is the DDG?

1. PVH
2. PAH
3. Congenital abnormality
4. Emphysema
5. Shunt vascularity

pattern? - Then- what is the DDG?



Included in the DD?

1. Pulmonary edema
2. ARDS vs
3. Multilobar bronchopneumonia
4. Massive aspiration
5. All the above

Answer

- Consolidative pattern, air bronchograms, fluffy/ cloud-like opacities. Small lt pleural effusion.
  - Imp: Bilateral airspace disease c/w pulmonary edema vs. ARD vs multilobar bronch-pneumonia vs. massive aspiration

(All)